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DARTONFIELD ESTATE—VISITORS' DAYS

The *second* and *fourth* Wednesdays in each month have been set aside as Visitors' Days at Dartonfield estate, and the services of technical officers will be available to visitors on those days. The estate superintendent will be available every Wednesday. Visitors are requested to arrive on the estate not later than 9-30 a.m.

While visitors will be welcomed at the Station on other days, any particular member of the staff may not be free to give them attention unless an appointment has been made.

Dartonfield estate is situated about $3\frac{1}{2}$ miles from the main Matugama-Agalawatta Road, the turn-off being near culvert No. 14/10. The distance from Colombo is approximately 47 miles.

PUBLICATIONS

Rubber Research Scheme publications comprising Annual Reports, Quarterly Circulars and occasional Bulletins and Leaflets, are available without charge to the Proprietors (resident in Ceylon) Superintendents and Local Agents of Rubber estates in Ceylon over 10 acres in extent. Application for registration should be made to the Director, stating the name, acreage, and registered number of the estate(s) concerned.

IDENTIFICATION OF CLONES

The attention of Proprietors and Superintendents undertaking replanting or budgrafting programmes is drawn to Planting Manual No. 5: "The History and Description of Clones of *Hevea Braziliensis*" issued by the Rubber Research Institute of Malaya, copies of which may be purchased on application to these Laboratories for Rs. 5-00 each (postage free.) This publication gives drawings and descriptive particulars of the more important clones, which should enable Superintendents to verify the authenticity of their material.

SALE OF PLANTING MATERIAL IN 1939.

BUDWOOD AND BUDDED STUMPS.

The sale of budwood and budded stumps in 1939 will be restricted to estates which come within the purview of the Smallholdings Department, subject to special arrangements being made for the distribution of material of new clones when available. For this purpose a Smallholder is defined as the Proprietor of land planted with Rubber of a total area not exceeding 30 acres. Applications will be called for by advertisement in the Press in about September, 1938.

Prices (including packing charges):—

Budwood	...	50 cents per yard.
Budded Stumps	...	25 cents each.

A deposit of 25 per cent of the value of the material will be required within 14 days of allocation and full payment will be required before delivery.

SEED.

No Rubber seed is sold by the Research Scheme.

CORRIGENDA.

Quarterly Circular Vol. 15, Part 1.

(1) On page 12, second line from bottom, the words "14 gauge" should read "13 gauge."

(2) In the graph facing page 19 the dotted line depicting the scale of assessment of budded trees should be continued to the level of 1,000 lb. per acre at 9-10 years old.

SALE OF PLANTING MATERIAL IN 1939.

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THE PERFORMANCE OF IMPORTED CLONES IN CEYLON.—II.

R. K. S. MURRAY,
BOTANIST AND MYCOLOGIST

INTRODUCTION.

THE first of this series of articles, which was published in Rubber Research Scheme *Quarterly Circular*, Vol. 13, Parts 2 and 3, 1936, gave records of growth and yield of imported clones in Ceylon for the year 1935. Since then the number of records received at these laboratories has increased greatly, but owing to the writer's absence from Ceylon during the greater part of 1937 the figures for 1936 have not been published. The following notes summarise the yield records which have been received up to the end of March, 1938.

PRESENTATION OF RESULTS.

All the figures given below are derived from the test tapping of groups of trees of varying numbers rather than from the commercial tapping of whole clearings. Test tapping is open to the objection that the results are only representative of an average stand if all the trees in a particular group are tapped, or if the selection of trees for tapping is a random one. The methods of test tapping, selection of trees, etc., have not always been under our control, and some of the records received from estates are considered to be of greater value than others. The procedure adopted in this report is to give (in Table I) the results from a number of selected sources where interesting comparisons between clones grown under similar conditions can be made, and then (in Table II) to group all the available figures by clones. Explanatory notes, giving information that has a bearing on the yield figures, are given for each estate mentioned in Table I.

The first column in Table I gives the headings under which information is furnished. Attention is drawn to the fact that the yields are actual weights of dry rubber per tree obtained

for the particular tapping period. This is not always a full year, and the figures must therefore be considered in conjunction with the information given under the heading "period of tapping." The number of trees from which the records are derived is the figure in brackets immediately preceding the designation of the clone.

In Table II the yields are expressed as lbs. of rubber per tree per annum for the various agė classes. Where the period of tapping is less than a full year the figure has been calculated from the data available. The age is taken to the nearest half year from the time of budding or planting to the middle of the tapping year.

Unless otherwise stated the tapping system in all cases is half spiral alternate daily.

NOTES ON TABLE I.

IRIYAGAMA DIVISION, EXPERIMENT STATION. PERADENIYA.

The buddings were planted as budded stumps in October, 1929, and the seedlings as basket plants at the same time. The land was cleared from virgin jungle but growth was rather slow until manure was applied for the first time in 1935. Tapping was started in July, 1937, and the records given refer to the six months' period July-December, 1937. The system was half spiral on alternate days, cuts being opened at a height of 36 inches above the union on the budded trees and 24 inches above the ground on the seedlings. The bark consumption was $\frac{3}{4}$ inch per month for the former and $\frac{1}{2}$ inch for the latter.

The clones are arranged in five randomised blocks of 12 trees each so that a critical comparison is afforded. The number of trees in tapping out of the total of 60 in each clone gives an indication of the relative rates of growth but does not quite represent the percentage of trees tappable as in replications where only one or two trees of a particular clone were of the requisite girth this plot was not tapped at all. Were the records to be calculated on a plot rather than on a tree basis those clones with a large percentage of trees in tapping would, of course, show up in a relatively more favourable light. Clone Heneratgoda 2 and the seedlings (unselected) are included for comparison. The excellent performance of Tjirandji 1 is noteworthy, and Tjirandji 16 also shows up well in respect of both growth and yield.

ESTATE A. KALUTARA DISTRICT.

Budding was carried out from March-September, 1931, on stocks planted in 1927. The clearing, which was opened from jungle, has been regularly manured and the conditions for growth and yield may therefore be considered to be favourable. The average number of trees per acre is 146.

Tapping was started in March, 1937, when the trees were $5\frac{1}{2}$-6 years old. Blocks of 200 trees were selected in each monoclonal area, and 100 tapped on alternate days. Cuts were opened at 42 inches from the ground.

As in almost all these comparisons Clone TJ. 1 shows up well ahead of the other clones. Although no exact figures for the percentage of tappable trees are available this clone takes first place in this respect also. B.D. 5 has shown the slowest growth, and the earliest commercial yields from these blocks will doubtless give this clone a less favourable position than it occupies in the test tapping list.

ESTATE B. KALUTARA DISTRICT.

On this estate some of the best Ceylon clones are being test tapped under similar conditions to the imported clones, and the most interesting of the two series are shown in Table I. The imported clones were budded in the field in June, 1930. Clones Hillcroft 28 and 55 and Heneratgoda 2 were budded at the same time, but the three Millakande clones are a year older. Clones TJ.1, MK.1/1, MK.3/2 and MK.4/3 were taken into tapping in March, 1934, Hillcroft 55 in April, 1935, and B.D.2, B.D.5, B.D.10, and Hillcroft 28 in April, 1936. In every case the 10 trees in test tapping were selected in as compact a block as possible, but since at the time tapping was commenced the trees were not all up to the requisite girth the yields are rather higher than would be obtained from the average 10 trees. At the end of 1936 one tree of TJ. 1 developed Brown Bast, so the cuts were shortened to $\frac{1}{3}$ circumference. Otherwise all tapping has been on a half spiral on alternate days. The rubber is sent to Dartonfield each month to be weighed.

Except for Heneratgoda 2, which is known to be a poor yielder in the early years, the local clones compare favourably with the imported material. TJ.1 has given a satisfactory yield on the short cut, and in view of its liability to develop Brown Bast in the early years it should possibly always be tapped on a milder system than $\frac{1}{2}$ spiral alternate daily.

ESTATE C. RATNAPURA DISTRICT.

This area was opened from jungle in 1927 and planted with unselected seedlings at about 170 per acre. In 1929 alternate plants were budded and the remainder left unbudded. In November, 1934, a group of 12 buddings of TJ.1 and the 12 alternating seedlings were opened for test tapping, and in January, 1936, the other clones were taken in. The trees selected are in a well grown part of the clearing but are not the biggest in the respective clones.

The yields shown in Table I are those for 1936 when the seedlings were 9 years old and the buddings two years younger. Test tapping was stopped early in 1937. The comparison between the TJ.1 trees and the alternating seedlings is interesting as showing the advantage gained by budding despite the set-back in growth. The yields of the A.V.R.O.S. clones are disappointing.

ESTATE D. KALUTARA DISTRICT.

These yields are derived from an area of about 5 acres which was replanted with budded stumps in 1930. It was chosen as being the poorest piece of land on the estate and received no manure during the first three years. Test tapping was commenced on 1st April, 1937. Not all the trees had at that time reached tappable size, and the degree of selection can be judged by the fact that 287 trees were tapped out of a total of 445, *i.e.*, about 65 per cent.

The figures in Table I are derived from 9 months' tapping. With the exception of B.D. 10 the level of yield is considerably below average, but this is fully accounted for by the unfavourable past history of the area. TJ.16 occupies a lower position than usual in relation to the other clones.

ESTATE E. KURUNEGALA DISTRICT.

This estate has been included as representative of one of the drier districts. The average annual rainfall is given in the Table as 87 ins. but the actual fall in 1937 was only 77 ins. The trees were budded in May-June, 1931 and taken into tapping in March, 1937, cuts being opened at 46 ins. from the union. The minimum girth was taken as 21 ins., and the Superintendent reports that the 100 trees of each clone are fairly representative of the buddings of this age. Much of the budding in this area was done later.

The yields of the two clones may be considered very satisfactory especially in view of the fact that the general level of yield on this estate and in the locality is very low. In neither case is there any indication of a pronounced reaction to the long dry spells which are so characteristic of the Kurunegala District.

ESTATE F. KEGALLE DISTRICT.

This estate has been included on account of the large number of clones in test tapping, for some of which we have no other records. The area was planted in September, 1930, on very poor soil, and in January, 1937, any trees which had reached the requisite girth were taken into test tapping. The trees are therefore the biggest in each clone and the yields are not representative of the whole stand.

ESTATE G. GALLE DISTRICT.

This area was replanted with budded stumps in July, 1931, and received no manure for the first three years. Test tapping was started in July, 1937, 60 consecutive trees over 18 inches in girth being selected in each block for the test. The degree of selection can be judged by the following figures showing the percentages of trees over 18 inches in girth in the four blocks:—

TJ. 1	...	74 per cent.
B.D. 5	...	48 ,, ,,
A.V.R.O.S. 49	...	79 ,, ,,
A.V.R.O.S. 256	...	69 ,, ,,

The average stand per acre is about 140. An estimate of the yields per acre per annum that would have been obtained had all trees of the requisite size been tapped gives the following figures:—

TJ. 1	...	673 lbs. per acre
A.V.R.O.S. 49	...	453 ,, ,, ,,
B.D. 5	...	305 ,, ,, ,,
A.V.R.O.S. 256	...	261 ,, ,, ,,

The selected seedlings, for which the yield of 30 trees is given in Table I, are derived from a high yielding tree on the estate.

ESTATE H. RATNAPURA DISTRICT.

Although there are records of only two clones from this estate the figures are included in this series since the number of trees is relatively large and full details of disease incidence etc., are available.

Clone Tjirandji 1 was budded in 1930-31 on 1928 stocks, and B.D. 10 in 1930-32 on 1927 stocks. Since the trees selected for test tapping were, on the whole, the biggest in the blocks it has been assumed that they were all the original 1930 grafts.

The land was opened from jungle and the plants have been manured every year since budding. B.D.10 is rather more favourably situated than TJ.1.

15 trees of TJ.1 and 5 of B.D.10 developed Brown Bast during the year, and there were a few cases of wind breakage in the B.D.10 block. Bark renewal is reported to be good, particularly in the case of B. D. 10.

The crepe being made from TJ.1 is yellow in colour but that from B.D. 10 is normal.

WAGOLLA PRACTICAL FARM SCHOOL, KEGALLE.

An area of about 5 acres on what was formerly known as the Kegalle Experiment Station (Department of Agriculture) was planted with budded stumps of imported and local clones in 1927-28. Casualties were apparently not supplied and for this and other reasons the present stand consists of only 202 trees. In 1933 the Station was closed down, and during the course of the next few years many of the identification stones were lost or the lettering obliterated. Consequently when interest in the area was revived in 1937 it was not possible to identify every tree. Test tapping was commenced in July, 1937, under supervision from the Experiment Station, Nivitigalakele, and the rubber biscuits are sent monthly to Dartonfield to be weighed.

The figures given in Table I show the yields for the six months' period July-December, 1937, of the small number of identified trees of certain interesting clones. With the exception of B.D. 10 the yields are at an extremely high level, *e.g.*, B.D. 5 has given the equivalent of 23.7 lbs. per tree per annum at 9-10 years old, but the results must be qualified by stating that the soil is a rich alluvial loam and the trees show exceptionally fine growth. Moreover the spacing is very wide.

It may be mentioned that the identification of the remaining trees will be undertaken at the earliest opportunity.

GENERAL NOTES ON TABLE II.

As stated earlier in this report Table II contains all the available figures grouped by clones. Although it is a somewhat motley assembly the aggregation of figures conveys a good picture of the performance of the several clones under a variety of conditions. The reader may at first remark upon the wide differences between the yields of the same clone at the same age on different estates, but it must be remembered that the environmental conditions, particularly soil and cultivation history, show great diversity. Examples of yields under various conditions are discussed above in the notes on Table I.

NOTES ON INDIVIDUAL CLONES.

Tjirandji 1.—Tjirandji 1 stands out as being the most productive of the imported clones (at least in the early years of tapping) under all conditions in which it has been tapped in Ceylon The growth, also, is uniformly vigorous. Less satisfactory features are:—

(1) Susceptibility to wind damage, particularly splitting at the lowest fork between the 5th and 8th years of age. This form of damage is particularly evident where the trees are planted in hollows and folds in the ground which form "wind funnels," and can probably be largely obviated by judicious pruning at 2-3 years old. The trouble is not common on hillsides where, from their earliest youth, the plants experience steady winds. and have grown less rapidly.

(2) The exceptionally heavy foliage which retards the drying of tapping cuts and may lead to trouble with bark diseases. It is possible that this clone should be restricted to the East face of hills which receive the drying influence of the morning sun.

(3) Liability to Brown Bast. It is probably true to say that any exceptionally high yielding material will display a tendency to develop this disease, and Tjirandji 1 is no exception. At present we are hardly in a position to say whether the incidence is sufficiently high to warrant the adoption of a relatively mild system of tapping, *e.g.*, $\frac{1}{2}$ spiral every three days or $\frac{1}{3}$ spiral on alternate days.

(4) Tendency for the yield to decrease markedly in dry weather. For this reason the clone is not recommended for the drier districts such as Kurunegala and Uva.

(5) Yellowness of the rubber.

(6) Tendency for the flow to continue into the afternoon.

Although this list of defects appears formidable they are not considered to be of sufficient importance to detract greatly from the value of the clone, and it has been freely recommended for replanting hilly land except in localities which are subject to prolonged periods of drought.

Tjirandji 8.—Of no special interest. The yields are only moderate and the trees are very liable to break in the wind.

Tjirandji 16.—The yields of this clone are very satisfactory especially on two estates in the relatively dry district of Kurunegala. The fact that the flow is not appreciably affected in periods of dry weather renders the clone particularly suitable for such localities. Bark renewals are reported to be particularly good. Although the growth is at first often rather weak, this is one of the few clones which appears to develop no important defect. Its late wintering habit renders the young foliage rather susceptible to Oidium infection, but in a monoclone block this could be satisfactorily and economically controlled by sulphur dusting.

Bodjong Datar 2.—Growth is strong and early yields are fair. Up to the present the trees have not shown the marked susceptibility to Brown Bast which is characteristic of this clone in Java.

Bodjong Datar 5.—The early yields are not very high but the clone is known to be late maturing. The exceptionally fine growth and high yield of a few trees on the Farm School, Wagolla, (at the rate of 23.7 lbs. per tree in the 10th year) suggest that the clone will do very well under the conditions which favour it. These are considered to be a deep fertile soil particularly in the drier localities, and it is for these conditions that the clone is specially recommended.

The first article of this series described a method of pruning in the second year of age with the object of stimulating the formation of a crown, and it is probable that this should be a standard form of treatment for buddings of this or any other clone whose branching is unduly delayed.

Bodjong Datar 10.—The early yields are at about the same level as those of B.D.5, but there are indications that subsequent increases may not be so satisfactory. Growth is strong, but for various reasons this clone has been discarded from planting programmes in other countries.

A.V.R.O.S. 49.—In common with all the A.V.R.O.S. clones the yields have so far proved disappointing. The growth is usually fairly, and sometimes very, vigorous, but for Ceylon conditions there seems no reason to recommend this clone in preference to higher yielding material.

A.V.R.O.S. 50.—The yields are about on a par with those of A.V.R.O.S. 49, and here, again, the clone has nothing special to commend it.

A.V.R.O.S. 152.—Growth is very vigorous in certain soils, but the limited yield records available do not show special promise.

Djasinga 1.—The early yields are mostly rather poor, and although the clone is reputed to be late maturing and the original trees in Java have attained satisfactory yields it seems unlikely to prove of commercial value in Ceylon.

Prang Besar Clones.—The records of these clones are rather fragmentary, and since 25, 86 and 186 have an excellent reputation in Malaya it is hoped that further yield figures in Ceylon will soon become available. P.B. 23 and 25 have been tapped for two years at the Experiment Station, Nivitigalakele, and have given disappointing results on a poor lateritic soil, P.B. 25, in particular, being unfavourably situated. The yields for the first few months of 1938, however, are more encouraging.

YIELDS OF ORIGINAL BUDDINGS.

As a corollary to this paper the yield records of the original buddings of the more interesting clones in the several countries of origin are given in Table III. In some cases test tapping has not been carried on continuously or, at least, the records have not been published, but all available figures are included.

PRESENT RECOMMENDATIONS.

The imported clones at present approved for replanting are as follows:—

Tjirandji 1.—Except in the drier districts and in low lying areas of "soft" soil where anchorage may be insufficient to support the heavy head of foliage.

Tjirandji 16.—Seems specially suitable for the drier localities.

Bodjong Datar 5.—Only in good soil. Seems to do particularly well in the deep fertile loams in the Kurunegala and parts of the Kegalle Districts.

Prang Besar 25.—A strong grower whose development is uniform under most conditions. Like Tjirandji 1 and Pilmoor B 84 it is probably one of the best clones for use in poor land.

Prang Besar 86.—The inclusion of this clone is mainly based on its very satisfactory history in Malaya.

Prang Besar 186.—Not recommended for the drier localities as the primary bark is hard and rather difficult to tap.

Glenshiel 1.—No yield records from Ceylon sources are available but its performance in Malaya is good and growth in Ceylon, though not very vigorous, is satisfactory. Records in Malaya indicate that the trees are best tapped once in three days.

Pilmoor B.84.—This clone has only recently been introduced to Ceylon, but the exceptionally vigorous growth and excellent secondary characteristics of the trees in Malaya suggest that it should be very suitable for replanting our average hilly land.

ACKNOWLEDGMENTS.

Grateful acknowledgment is made to the Superintendents of the estates from whom the records given in this paper were received, and to the proprietors for permission to use the figures.

TABLE I

YIELDS OF IMPORTED CLONES ON CEYLON ESTATES, GROUPED BY ESTATES.

TAPPING ON HALF SPIRAL ON ALTERNATE DAYS.

Estate	Iriyagama Div. Expt. Stn., Peradeniya			A			B		
District	Kandy			Kalutara			Kalutara		
Annual rainfall in inches	93			200			174		
When budded or planted	October, 1929			March-September, 1931			June, 1930		
Period of tapping	July-December, 1937 (6 months)			March, 1937-February, 1938			1937		
Yield in lbs. per tree for period stated. Number of trees tapped in brackets	(55)	TJ. 1	4·2	(200)	TJ. 1	7·2	(10)	TJ. 1	5·9*
	(52)	TJ. 16	3·2	(200)	B. D. 5	4·7	(10)	B. D. 10	4·9
	(39)	TJ. 8	2·4	(200)	B. D. 10	4·0	(10)	B. D. 2	4·8
	(22)	B. D. 5	2·3	(200)	A. V. R. O. S. 50	3·8	(10)	B. D. 5	4·7
	(54)	A. V. R. O. S. 49	2·1	(200)	A. V. R. O. S. 49	3·1			
	(44)	A. V. R. O. S. 50	2·1				(10)	*Hillcroft* 28	9·2
							(10)	*Hillcroft* 55	5·1
	(30)	Heneratgoda 2	1·5				(10)	*Heneratgoda* 2	3·3
	(55)	Seedlings (unselected)	1·1						
							(10)	*Millakande* 3/2 †	8·3
							(10)	*Millakande* 4/3 †	7·7
							(10)	*Millakande* 1/1 †	7.4

* Tapped on 1/3 circumference † Budded in 1929

TABLE I.—(*Contd.*)

Estate	C	D	E
District	Ratnapura	Kalutara	Kurunegala
Annual rainfall in inches	221	146	87
When budded or planted	1929	1930	May - June, 1931
Period of tapping	1936	April-December, 1937 (9 months)	March, 1937 - February, 1938
Yield in lbs. per tree for period stated. Number of trees tapped in brackets.	(12) TJ. 1 8·3 (12) B. D. 5 4·4 (12) A. V. R. O. S. 49 3.2 (6) A. V. R. O. S. 50 2·6 Seedlings (unselected) * 2·9	(29) B. D. 10 4·0 (19) B. D. 5 3·4 (77) TJ. 16 3·1 (50) A. V. R. O. S. 50 2·7 (51) A. V. R. O. S. 49 2·5 (61) Djasinga 1 1·8	(100) TJ. 16 6·6 (100) A. V. R. O. S. 49 4·7

* Planted in 1927

TABLE I.—*(Contd.)*

Estate	F		G		H		Wagolla Farm School	
District	Kegalle		Galle		Ratnapura		Kegalle	
Annual rainfall in inches	136		135		200			
When budded or planted	September, 1930		July, 1931		1930		July, 1928	
Period of tapping	1937		July, 1937 - March, 1938 (9 months)		April, 1937 - March, 1938		July - December, 1937 (6 months)	
Yield in lbs. per tree for period stated. Number of trees tapped in brackets.	(3) P. B. 86	8·6	(60) TJ. 1	4·9	(400) TJ. 1	8·1	(5) B. D. 5	11·9
	(22) B. D. 2	7·6	(60) B. D. 5	3·4	(400) B. D. 10	5·1	(4) B. D. 2	11·2
	(36) TJ. 1	7·4	(60) A.V.R.O.S. 49	3·1			(7) B. D. 10	4·1
	(21) TJ. 16	6·1	(60) A.V.R.O.S. 256	2·0				
	(1) P. B. 25	6·0					(3) B. R. 2 *	10·6
	(27) B. D. 10	5·7	(30) Seedlings (Selected)	1·6			(4) B. R. 1 *	7·6
	(7) S. R. 9	5·6					(3) S. R. 9 *	7·2
	(4) A.V.R.O.S. 152	5·5						
	(18) B. D. 5	5·4						
	(9) Ct. 88	5·4						
	(4) TJ. 8	5·2						
	(25) A.V.R.O.S. 50	5·0						
	(5) Djasinga 1	4·6						
	(4) P. B. 186	4·5						
	(17) A.V.R.O.S. 49	3·9						
	(2) P. B. 180	3·5						
	(27) A.V.R.O.S. 163	2·8						

* Planted in November, 1927

TABLE II

YIELDS OF IMPORTED CLONES ON CEYLON ESTATES, GROUPED BY CLONES.

TAPPING ON HALF SPIRAL ON ALTERNATE DAYS.

Clone	Estate	District	No. of trees	Yield in lb. per tree per annum at ages of (to the nearest half year)												
				4	4½	5	5½	6	6½	7	7½	8	8½	9	9½	10
TJ. 1	Iriyagama	Kandy	55	—	—	—	—	—	—	—	—	8·4				
do	A	Kalutara	200	—	—	—	—	7·2								
do	B	Kalutara	10	2·3	—	3·7	—	6·5	—	5·9*						
do	C	Ratnapura	12	—	—	—	—	6·6	—	8·3						
do	F	Kegalle	36	—	—	—	—	—	—	7·4						
do	G	Galle	60	—	—	—	—	—	6·5							
do	H	Ratnapura	400	—	—	—	—	—	—	8·1						
do	I	Kalutara	32	—	—	—	—	—	6·8	—	9·7					
do	J	Kegalle	46	—	—	—	—	—	—	—	—	7·0				
So	K	Kalutara	3-10	3·0	—	4·6	—	4·9	—	6·6						
do	L	Ratnapura	41	—	—	—	—	6·5	—	13·9						
do	R	Ratnapura	240	—	—	—	—	9·0								
TJ. 8	Iriyagama	Kandy	39	—	—	—	—	—	—	—	—	4·8				
do	F	Kegalle	4	—	—	—	—	—	—	5·2						
do	N	Kalutara	12					3·0	—	3·9						
TJ. 16	Iriyagama	Kandy	52	—	—	—	—	—	—	—	—	6·4				
do	D	Kalutara	77	—	—	—	—	—	—	3·6						
do	E	Kurunegala	100	—	—	—	—	—	6·6							
do	F	Kegalle	21	—	—	—	—	—	—	6·1						
do	I	Kalutara	29	—	—	—	—	—	5·5	—	7·2					
do	O	Kalutara	29	—	—	—	—	—	—	—	8·5					
do	P	Kurunegala	10	—	—	—	—	—	—	13·8						

* Tapped on ½ sp. a. d.

TABLE II.—(*Contd.*)

Clone	Estate	District	No. of trees	Yield in lb. per tree per annum at ages of (to the nearest half year)												
				4	4½	5	5½	6	6½	7	7½	8	8½	9	9½	10
B. D. 2	B	Kalutara	10	—	—	—	—	3·0	—	4·8						
do	F	Kegalle	22	—	—	—	—	—	—	7·6						
do	P	Kurunegala	10	—	—	—	—	—	—	9·0						
do	S	Matale	4	—	—	—	—	—	—	—	—	5·2*				
do	Wagolla	Kegalle	4	—	—	—	—	—	—	—	—	—	—	—	22·5	
B. D. 5	Iriyagama	Kandy	22	—	—	—	—	—	—	—	—	4·6				
do	A	Kalutara	200	—	—	—	—	4·7								
do	B	Kalutara	10	—	—	—	—	3·3	—	4·7						
do	C	Ratnapara	12	—	—	—	—	—	—	4·4						
do	D	Kalutara	19	—	—	—	—	—	—	4·0						
do	F	Kegalle	18	—	—	—	—	—	—	5·4						
do	G	Galle	60	—	—	—	—	—	4·5							
do	K	Kalutara	10	—	—	—	—	3·8	—	5·2						
do	P	Kurunegala	10	—	—	—	—	—	—	9·7						
do	S	Matale	14	—	—	—	—	—	4·0*							
do	Wagolla	Kegalle	5	—	—	—	—	—	—	—	—	—	—	—	23·7	
B. D. 10	A	Kalutara	200	—	—	—	—	4·0								
do	B	Kalutara	10	—	—	—	—	3·1	—	4·9						
do	D	Kalutara	29	—	—	—	—	—	—	4·7						
do	F	Kegalle	27	—	—	—	—	—	—	5·7						
do	H	Ratnapura	400	—	—	—	—	—	—	5·1						
do	P	Kurunegala	10	—	—	—	—	—	—	9·2						
do	S	Matale	5	—	—	—	—	—	—	—	—	3·5*				
do	Wagolla	Kegalle	7	—	—	—	—	—	—	—	—	—	—	—	8·3	

* Tapped on ½ sp. 3. d.

TABLE II.—(*Contd.*)

Clone	Estate	District	No. of trees	Yield in lb. per tree per annum at ages of (to the nearest half year)												
				4	4½	5	5½	6	6½	7	7½	8	8½	9	9½	10
A.V.R.O.S. 49	Iriyagama	Kandy	54	—	—	—	—	—	—	—	—	4·2				
do	A	Kalutara	200	—	—	—	—	3·1								
do	C	Ratnapura	12	—	—	—	—	—	—	3·2						
do	D	Kalutara	51	—	—	—	—	—	—	2·9						
do	E	Kurunegala	100	—	—	—	—	—	4·7							
do	F	Kegalle	17	—	—	—	—	—	—	3·9						
do	G	Galle	60	—	—	—	—	—	4·1							
do	N	Kalutara	12	—	—	—	—	3·4	—	3·8						
do	P	Kurunegala	10	—	—	—	—	—	—	7·8						
A.V.R.O.S. 50	Iriyagama	Kandy	44	—	—	—	—	—	—	—	—	4·2				
do	A	Kalutara	200	—	—	—	—	3·8								
do	C	Ratnapura	6	—	—	—	—	—	—	2·6						
do	D	Kalutara	50	—	—	—	—	—	—	3·1						
do	F	Kegalle	25	—	—	—	—	—	—	5·0						
do	P	Kurunegala	10	—	—	—	—	—	—	7·4						
A.V.R.O.S. 80	N	Kalutara	12	—	—	—	—	3·0	—	4·1						
A.V.R.O.S. 152	F	Kegalle	4	—	—	—	—	—	—	5·5						
do	N	Kalutara	12	—	—	—	—	3·5	—	5·4						
do	P	Kurunegala	10	—	—	—	—	—	—	6·9						
A.V.R.O.S. 163	F	Kegalle	27	—	—	—	—	—	—	2·8						
do	P	Kurunegala	10	—	—	—	—	—	—	4·9						
A.V.R.O.S. 256	G	Galle	60	—	—	—	—	—	2·7							

TABLE II.—(*Contd.*)

Clone	Estate	District	No. of trees	Yields in lb. per tree per annum at ages of (to the nearest half year)												
				4	4½	5	5½	6	6½	7	7½	8	8¼	9	9½	10
Djasinga 1	D	Kalutara	61	—	—	—	—	—	—	2·1						
do	F	Kegalle	5	—	—	—	—	—	—	4·6						
do	N	Kalutara	12	—	—	—	—	2·6	—	3·6						
do	Q	Kalutara	10	—	—	—	4·2	—	5·0	—	6·1					
Ct. 88	F	Kegalle	9	—	—		—	—	—	5·4						
do	P	Kurunegala	10	—	—		—	—	—	9·4						
P. B. 23	Nivitigalakele	Kalutara	10	—	—		1·3	—	2·7							
do	Q	Kalutara	3	—	—	3·7	—	3·6	—	5·5						
P. B. 25	Nivitigalakele	Kalutara	9	—	—		—	1·4	—	3·9						
do	Q	Kalutara	3	—	—	5·1	—	6·8	—	8·2						
P. B. 86	F	Kegalle	3	—	—	—	—	—	—	8·6						
P. B. 186	F	Kegalle	4	—	—	—	—	—	—	4·5						
S. R. 9	F	Kegalle	7	—	—	—	—	—	—	5·6						
do	Wagolla	Kegalle	3	—	—	—	—	—	—	—	—	—	—	—	—	14·4
B. R. 1	Wagolla	Kegalle	4	—	—	—	—	—	—	—	—	—	—	—	—	15·2
B. R. 2	Wagolla	Kegalle	3	—	—	—	—	—	—	—	—	—	—	—	—	21· 2

TABLE III

YIELD OF ORIGINAL BUDDINGS IN COUNTRIES OF ORIGIN.

Clone	Year planted or budded	No. of trees	Yield in lb. dry Rubber per tree at ages of (to nearest half year)																											
			4½	5	5½	6	6½	7	7½	8	8½	9	9½	10	10½	11	11½	12	12½	13	13½	14	14½	15	15½	16	16½	17	17½	18
TJ. 1	1920	2	—		—		—		—		30·6		26·6		35·2		41·4		33·4		42·9		39·6		42·5		86·2			
TJ. 16	1920	9	—		—		—		—		24·0		23·8		20·2		21·3		27·5		20·4		25·5		27·9		45·1			
B. D. 5	1918	7		—		—		—		—		18·5		25·3		26·0		26·6		29·9		36·1		34·5		33·7		31·7		31·7
B. D. 10	1918	40		—		—		—		—		15·7		18·9		20·0		17·8		21·1		21·8		21·3		23·1		22·8		
Djasinga 1	1920	135		—		—		—		—		9·7		11·0		15·0		14·3		17·2		19·8		24·2		23·5		20·0		
A.V.R.O.S. 49	1919	4		3·1		6·4		9·2		11·4		10·6		13·2		17·2		19·6		23·1										
P. B. 25	1922	10		—		12·4		13·9		15·1		20·1		22·1		22·9		—		—		—		28·5*						
P. B. 86	1923	10	10·2		12·3		14·9		18·5		21·1		23·9		—		—		—		27·9*									
P. B. 186	1922	10		—		11·2		15·6		20·6		27·6		26·3		29·5		—		—		—		26·9*						
Glenshiel 1	1921	20	—		—		10·7		11·1		22·7		22·4		22·2		25·9		22·1		20·3									
Pilmoor B. 84	1924	18	5·3		7·0		9·2		12·3		15·9		18·5		19·2		21·5													
Pilmoor D. 65	1924	5	4·4		11·0		15·8		18·9		20·0		26·0		23·2		23·0													

* Figures calculated from recent test tappings.

CEYLON CLONES—VI.

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FOREWORD

THIS article, presenting data for 1937, is the sixth of a series of annual reports on the test tapping of Ceylon clones.

Acknowledgment is made to the undermentioned proprietors who have kindly given permission for the publication of the records of clones established from mother trees on their properties:—

Rosehaugh (Ceylon) Rubber Co., Ltd.
Mirishena (Kalutara) Rubber Co., Ltd.
Ceylon Rubber Co., Ltd.
Beau Sejour Rubber Co., Ltd.
Dalkeith (Ceylon) Rubber Estates, Ltd.
Bandarapola Ceylon Co., Ltd.
Kiriella Estate Co., Ltd.

We are also indebted to the Superintendents of Stennes and Millakande Tea Estates for their co-operation.

PRESENTATION OF RESULTS.

As in previous years the yield records are presented in two Tables. Table I gives the average yield per tree per tapping in grams for each year the trees have been tapped and the actual yield in lb. per tree during 1937, while in Table II the yields are calculated on the basis of 130 tappings on the half spiral alternate day system so as to make the results from the various clones as comparable as possible. The age is calculated to the nearest half year from the time of budding or planting to the middle of the tapping year.

In an attempt to compare the productive capacity of Ceylon and imported clones the yields of the best local clones and

those of certain imported clones growing on the same estates are brought together in Table III. The results are discussed under the appropriate heading.

GENERAL NOTES ON TABLES I AND II.

Comparison with previous reports will show that the older clones at the Experiment Station, Nivitigalakele, have been omitted from the records. They have all been tapped for at least four years, and although in every case the yield has shown a progressive annual increase, for no clone has it exceeded the figure of 10 lb. per tree in the 10th year of age. This is considered insufficient to merit continued publication, but records are still being kept and if any clone attains a very high yield at a later stage it can be reinstated in this series.

Several new clones are included for the first time, and although some of the yields are not outstanding they compare favourably with those of clones Prang Besar 23 and 25 tapped in the same area (see Table III.)

The yields of a group of unselected seedlings are also given for comparison. This is a plot of the original stocks which was left unbudded, and as budding was delayed they have an advantage of about two years.

SELECTION OF TREES FOR TEST TAPPING.

The value of records derived from the test tapping of a small group of trees is largely dependent on the method by which these trees were selected. Although there is a high degree of uniformity amongst the individuals of a single clone there are obviously variations due to soil differences, position and possibly stock influence. If, for example, the largest 10 trees out of a total of 100 are selected for tapping the records may represent the yields which will be obtained when the average girth of the 100 trees is up to that of the 10, but will not give a true picture of the productive capacity of the clone at any particular age. For the test tapping figures to be truly representative they must be derived either from the full stand or from a sample chosen at random.

When test tapping was started at Nivitigalakele the procedure adopted was to tap the first 12 trees (out of a total of about 100 for each clone) to attain the requisite girth. In this way it was possible to obtain the earliest indication of any promising material but it was always recognised that such records were of a preliminary nature. Later clearings were

planted in blocks of approximately 25 trees to a clone, and the present method of selection for test tapping is to wait until all the original grafts, (*i.e.*, excluding later supplies) have attained a girth of 18 inches and then choose 10 trees at random. The trees from which the records are derived are therefore of all sizes and are believed to be fair representatives of an average stand. This method of selection was adopted for all clones tapped at Nivitigalakele for which the records are given in this paper with the exception of Millakande 3/2. The 12 trees of this clone originally taken into tapping were the largest of a block of 51 (excluding supplies).

On Stennes Estate the 24 trees of Clone Hillcroft 28 in tapping are rather larger than the average of the whole block, but the 9 (originally 10) trees of Hillcroft 55 constitute a random sample.

On Millakande Estate the 10 trees of each clone were selected in as compact a block as possible, but since at the time tapping was commenced the trees were not all up to the requisite girth the yields are doubtless rather higher than would be obtained from the average 10 trees. On the other hand the planting density is rather high and the conditions for growth not very favourable.

NOTES ON INDIVIDUAL CLONES.

Millakande 3/2.—The yield of 42.5 grams per tapping at 7 years old is outstanding, but as mentioned above this must be qualified by stating that the trees are the biggest in the block. Moreover two trees developed Brown Bast early in 1937 and the yield per tree is calculated on 10 rather than on the full number of 12 trees. A further group of 41 trees tapped semi-commercially throughout the year averaged only 16.4 grams per tapping or 4.7 lbs. per tree on the basis of 130 tappings. It is difficult to account fully for the big difference in yield between the two groups though the difference in size of the trees is doubtless the main factor. The cuts were also at a higher level on the trees in commercial tapping. On Millakande Estate itself the yield has shown a satisfactory increase, and is rather higher than TJ.1 of similar size but a year younger.

As mentioned in earlier reports the growth of this clone is very vigorous and the trees have an attractive straight trunk. Bark renewal is excellent. Two trees have developed Brown

Bast out of a total of 63 in tapping. The trees have the same late dripping habit as TJ.1, and if crop is not to be lost a second cup must be used.

Millakande 1/1.—The yields on both Nivitigalakele and Millakande are very promising particularly in relation to the size of the trees. Growth is rather weak and the clone may on that account be unsuitable for replanting poor soils, but the trees have developed no defects.

Millakande 4/3.—This clone has not been mentioned in previous reports but the big increase for 1937 brings the yield up to the promising figure of 25.7 grams per tapping at 8 years old. No observations were made on the early vigour of growth but the trees have now developed into quite attractive specimens. The trunk has a somewhat uneven appearance owing to the protuberance of buds, but this is not sufficiently marked to interfere with tapping.

Hillcroft 28.—Throughout 1936 and 1937 the original trees on Stennes Estate were tapped once in three days on account of the incidence of Brown Bast. No further cases of disease have occurred on either the trees in test tapping or the remaining buddings in commercial tapping, but the longer interval does not appear to suit this clone. Not only was the total yield reduced but the yield per tapping was less than on the alternate day system. Since March, 1938, tapping has reverted to the alternate day interval and the yields have shown a marked increase. It remains to be seen whether Brown Bast will again be troublesome.

On Nivitigalakele and Millakande the yields of younger buddings are very high, and it would seem that in the early years the productive capacity of this clone is at least as great as that of any of the imported clones.

Apart from the tendency to develop Brown Bast the only important defect is the spiral fluting of the stem. This makes the trees look ugly but rarely interferes seriously with tapping, and the renewed panels seem to be flattening out. The latex is very yellow.

Hillcroft 55.—On Stennes Estate the improvement in yield shown in 1936 was not maintained, but the figure of 12 lb. per tree for third day tapping is not unsatisfactory. Since March, 1938, tapping has reverted to the alternate day interval. On Millakande Estate the yield for 1937 was disappointing, but it shows a good increase for the early months of 1938.

The unusual disparity between the yields of individual trees amongst the original buddings on Stennes still persists: the poorest tree gave only 3.5 lb. in 1937 as compared with 18.9 lb. from the best tree, and the figures show almost every gradation between these two extremes. A possible explanation is that the clone is unusually susceptible to stock influence, but test buddings made recently from certain of the individuals suggest that the group may not be entirely homogenous. In applying tests for the identity of the individual grafts some of the results are puzzling and inconsistent, and the position at the time of writing is rather obscure. It is hoped that the matter will be clarified before the next number of this series is issued.

Wagga 6278.—The yield of this clone in 1936, the first year of tapping, was not specially promising, but in 1937 it rose to 28.7 grams (almost exactly 1 oz.) per tapping, which is an outstanding figure for seven year old buddings under Ceylon conditions. The trees are planted within about 50 yards of plots of Clones Prang Besar 23 and 25 which averaged only 9.5 and 13.5 grams respectively for the same period. (The trees of P.B. 23 are 6 months younger).

The growth is exceptionally vigorous as exemplified by the fact that the average increase in girth of the trees in tapping for the period July, 1936 to June, 1937 was 6.6 inches. The trees tend to be slightly crooked but the surface of the stem is free from irregularities. The branching is of a type unlikely to be subject to wind damage. Up to the present the clone has developed no defect and is considered to be of exceptional promise.

The reason for the number of trees in test tapping being 7 instead of 10 is that 3 of the trees originally selected were found to be "rogues."

Of the other clones mentioned in the Tables no special notes will be given at the present juncture. The yields are not very high but the clones were included as being up to the standard of the "proved" Prang Besar clones planted in the same area.

COMPARISON OF LOCAL WITH IMPORTED CLONES.

Up to the present time the material used for replanting programmes in Ceylon has almost exclusively consisted of bud-grafts of clones introduced from Malaya and the Netherlands East Indies. All these clones were established in the countries

of origin prior to 1924 and have therefore a much longer tapping history than any Ceylon clone. The time is now coming, however, when consideration may be given to the use of local clones in preference to, or in conjunction with, imported clones. That Ceylon can produce material as good as that of other countries cannot be doubted; indeed the fact that most of the trees further East owe their origin to Ceylon seed suggests a greater degree of heterogeneity and therefore a fuller scope for selection in this country. The two questions to be answered are: (1) How do the yields of the best Ceylon clones compare with those of the best imported clones? (2) At what stage can we consider a local clone to be sufficiently tested to be safely recommended for commercial planting?

Comparison of the performance of Ceylon clones in Ceylon and imported clones in their countries of origin is an unsatisfactory guide for obvious reasons, and we must turn to the study of their relative yields in this country. The most useful figures at present available are those from the Experiment Station, Nivitigalakele, and from Millakande Estate, and these are reproduced in Table III. In neither case are the comparisons strictly critical as there is no replication, but subject to the qualifications mentioned below the figures are thought to give a useful indication of the relative yields under the particular local conditions.

All the clones mentioned in Table III as being tapped at Nivitigalakele are planted in the same clearing with the exception of Millakande 1/1 which stands in an area of similar soil about 200 yards away. The plot of Prang Besar 25 is situated towards the top of a low hill and its position is less favourable than that of the other clones. The soil is of the lateritic gravelly type so characteristic of the moist low-country zone where there is no outcrop of rock. Early growth and yields are usually at a low level on this type of land. All clones have received identical treatment in respect of cultivation, tapping, etc. It will be noted that the yield of the three Ceylon clones is approximately twice that of the Prang Besar clones which have been proved to give high yields in Malaya. When due allowance is made for the possibility of the latter being unsuited to the particular environmental conditions, the impression still remains that the Ceylon material gives great promise of developing high yields.

Clone Millakande 3/2 is not included in this comparison because of the different method by which the trees were selected

for test tapping, but the results from Millakande Estate show that it is of approximately equal merit to the other Ceylon clones.

On Millakande Estate the clones are scattered in various fields and the comparisons cannot be pressed too strongly. Hillcroft 28 is favoured as regards position while the Bodjong Datar clones are in rather an exposed situation.

The general conclusion to be drawn from these very incomplete comparisons is that the early yields of the best Ceylon clones compare well with those of the imported clones which are at present being extensively used for replanting. It is considered, however, that a new clone must be tapped for at least five years before its commercial use in monoclone blocks can be recommended with any confidence, and during this time observations must be made on such secondary characteristics as bark renewal, susceptibility to Brown Bast, wind damage, etc. The only clones under our observation which come into this category are Hillcroft 28 and 55. The yields and other characteristics of these clones are presented in this and earlier papers, and the present view of the Research Scheme is that these clones might be planted in monoclone blocks on a relatively small scale.

Clones Millakande 3/2, 1/1 and 4/3 and Wagga 6278 are very promising and might be used as one partner in a duoclone planting. For example, buddings of Wagga 6278 could be planted alternately with those of a well tested clone such as TJ.1 at a total density of at least 200 to the acre. When the original trees of the local clones have been under observation for a further three or four years a decision could be made as to which clone to retain. All or most of the trees of the other clone would then be removed, and up to the age of three or four years the initial close planting would not have proved detrimental.

TABLE I

Clone	Where tapped	No. of trees	Average Age in years on 1-7-37	Average Girth ins at 3 ft. on 1-7-37	Average yield in grams dry rubber per tree per tapping for years: 1932	1933	1934	1935	1936	1937	No. of tap-pings in 1937	Yield per tree in lb. in 1937	Tapping system in 1937
Millakande 3/2	Nivitigalakele	12-10	7	33·0			10·7	21·1	30·4	42·5	121	11·3	½sp.a.d.
Ditto	Millakande	10	8	27·0				13·7	23·0	27·7	136	8·3	do
Millakande 1/1	Nivitigalakele	9-10	7	22·8					15·9	26·0	117	6·7	do
Ditto	Millakande	10	8	24·0				15·3	22·0	24·6	136	7·4	do
Millakande 4/3	Ditto	10	8	26·0				11·2	15·8	25·7	136	7·7	do
Hillcroft 28	Stennes	12	11	38·1	41·9	46·7	60·9	69·3	64·5	56·6	89	11·1	½sp.3.d.
Ditto	Ditto	12	11	34·1				73·7	58·7	55·5	89	10·9	do
Ditto	Nivitigalakele	10	6½	26·7					15·5	26·3	119	6·9	½sp.a.d
Ditto	Millakande	10	7	28·0					23·1	31·1	134	9·2	do
Hillcroft 55	Stennes	9	11	37·0		49·1	53·3	55·3	67·6	60·7	90	12·0	½sp.3.d.
Ditto	Millakande	10	7	23·0				10·4	17·6	17·6	131	5·1	½sp.a.d.
Wagga 6278	Nivitigalakele	7	7	29·1					8·4	28·7	121	7·6	do
Beau Sejour 3	Ditto	10	7	23·1					13·5	15·9	119	4·2	do
Diyaberiyakande 1	Ditto	9	7	24·2					6·2	13·6	120	3·6	do
Dalkeith 1	Ditto	10	7	24.5					6·0	13·3	121	3·5	do
Dalkeith 5315	Ditto	10	7	25·2					4·6	13·2	120	3·5	do
Bandarapola 8	Ditto	10	6½	21·7					8·0	13·2	119	3·5	do
Kiriella 11	Ditto	10	7	25·5					8·0	13·7	120	3·6	do
Seedlings (unselected)	Ditto	10	9	28·4					10·0	15·0	121	3·9	do

½ sp.a.d. = Half spiral cut on alternate days.
½ sp.3.d. = ,, ,, ,, once in three days.

TABLE II

Clone	Where tapped	No. of trees	Calculated yield in lb. per tree for 130 tappings on ½ sp. a.d. at ages of (to nearest half year):														
			4	4½	5	5½	6	6½	7	7½	8	8½	9	9½	10	10½	11
Millakande 3/2	Nivitigalakele	12-10	3·0		6·0		8·7		12·2								
do	Millakande	10	—		—		3·9		6·5		7·9						
Millakande 1/1	Nivitigalakele	9-10	—		—		4·5		7·4								
do	Millakande	5-10	—		—		4·3		6·3		7·1						
Millakande 4/3	do	10	—		—		3·2		4·5		7·4						
Hillcroft 28	Stennes	12	—		—		12·0		13·4		17·4		19·8		15·2		14·0
do	do	12	—		—		—		—		—		12·7		13·4		13·6
do	Nivitigalakele	10		—		4·5		7·5									
do	Millakande	10	—		—		6·6		8·9								
Hillcroft 55	Stennes	9	—		—		—		14·0		15·2		13·4		16·1		15.0
do	Millakande	10	—		2·6		5·1		5·1								
Wagga 6278	Nivitigalakele	7	—		—		2·4		8·2								
Beau Sejour 3	do	10	—		—		3·9		4·5								
Diyaberiyakande 1	do	9	—		—		1·8		3·9								
Dalkeith 1	do	10	—		—		1·7		3·8								
Dalkeith 5315	do	10	—		—		1·3		3·8								
Baṇḍarapola 8	do	10		—		2·3		3·8									
Kiriella 11	do	10	—		—		2·3		3·9								
Seedlings (unselecte)d	do	10	—		—		—		—		2·9		4·3				

TABLE III

Clone	Where tapped	Year budded	Average girth ins. at 3 ft. on 1.7.37	Calculated yield in lb. per tree for 130 tappings at ages of :						
				5	5½	6	6½	7	7½	8
Millakande 1/1	Nivitigalakele	1930	22·8	—		4·5		7·4		
Hillcroft 28	do	1930	26·7		4·5		7·5			
Wagga 6278	do	1930	29·1	—		2·4		8·2		
Prang Besar 23	do	1930	23·1		1·3		2·7			
Prang Besar 25	do	1930	24·4	—		1·4		3·9		
Millakande 3/2	Millakande	1929	27·0	—		3·9		6·5		7·9
Millakande 1/1	do	1929	24·0	—		4·3		6·3		7·1
Millakande 4/3	do	1929	26·0	—		3·2		4·5		7·4
Hillcroft 28	do	1930	28·0	—		6·6		8·9		
Hillcroft 55	do	1930	23·0	2·6		5·1		5·1		
Tjirandji 1	do	1930	28·0	3·3		6·1		5·7*		
B. D. 2	do	1930	20·5	—		3·0		4·6		
B. D. 5	do	1930	22·0	—		3·3		4·5		
B. D. 10	do	1930	21·0	—		3·1		4·7		

* Tapped on 1/3 spiral

THE EXPERIMENTAL MANUFACTURE OF VULCANISED PRODUCTS AT DARTONFIELD.

M. W. PHILPOTT,
CHEMIST.

DURING the last few years rubber research organisations throughout the world have been giving increased attention to the development of new uses and the expansion of the consumption of rubber. A number of investigations which were initiated with this object are now yielding interesting and valuable results and there is little doubt that the industry as a whole will benefit from the new knowledge thus acquired.

It may be recalled that in 1934 the policy of the Ceylon Rubber Research Board in regard to consumption research was defined in a statement of policy which was submitted to the Central Board of Agriculture in May of that year. In that statement it was made clear that research on new uses must usually be carried out by those in close touch with the requirements of the industries in which it is proposed to extend the use of rubber and it was therefore necessary, generally speaking, that such work should be done in the manufacturing centres of the world. At the same time it was proposed to give attention to such new applications of rubber as could suitably be investigated in Ceylon and to investigate the scope for local manufacture of vulcanised goods, especially such as could be made direct from latex or in association with other local raw materials.

In pursuance of this policy experimental work on the production of vulcanised products has been undertaken at Dartonfield during the past three years and latterly a few simple articles have been produced on a small semi-commercial scale to illustrate

the processes involved. The Research Board considers that the methods of producing vulcanised products have now been adequately demonstrated to potential local industrialists and it has been decided that attention will be turned to problems which are of more direct importance to the rubber producer. The present is, therefore, a suitable time to review the subject and it is the purpose of this report to outline the processes used in rubber manufacture and to describe the steps which have been taken to demonstrate them.

THE VULCANISATION PROCESS.

As many readers will not be familiar with rubber manufacturing methods it may not be out of place to describe, in outline, the processes through which the raw material passes in the course of its conversion into a finished article.

Raw rubber possesses certain properties which make it quite unsuitable for direct use without modification. Although it may be stretched and deformed to a remarkable extent it does not return to its original shape when released; it has relatively little physical strength; it is readily attacked by oils and many solvents; and, as many producers know to their cost, it becomes soft and sticky under the influence of heat, light and oxidising conditions. Fortunately all these disadvantages can be overcome if the rubber is heated together with sulphur, that is to say, if it is vulcanised.

The fundamental nature of vulcanisation is by no means completely understood but its effects are well known. As a first approximation to the truth it may be said that the changes which rubber undergoes during vulcanisation are brought about by the chemical combination of rubber with sulphur, the changes becoming progressively more marked as the proportion of combined sulphur increases. The important fact is that by suitable treatment with sulphur, rubber becomes stronger and more highly elastic, far less sensitive to temperature changes and comparatively resistant to the action of oils and solvents.

This treatment with sulphur, then, is an essential part of the manufacturing process and all the more important operations in the factory are directly or indirectly connected with it.

Starting with clean raw rubber the first stage in manufacture is to "masticate" the rubber on heated rollers so that it

becomes soft and plastic. To those who are acquainted with the demands of the rubber market and the pre-occupation of brokers with such qualities as "nerve," absence of bubbles, regular marking and so on, it is often a matter for surprise that the manufacturer's first operation should be to destroy the nerve and to treat the rubber in such a manner that any superficial blemishes in the raw material can have no possible influence on the quality of the finished product. The question of market valuation in relation to quality is, however, a subject on which discussion would be out of place in this article.

When the rubber is in a soft, putty-like condition the sulphur needed for vulcanisation is added, together with such other materials as are required to modify the appearance and mechanical properties of the product.

A word should be said at this stage about the nature and function of the ingredients other than sulphur which are mixed into the rubber on the masticating or mixing mill. It is important to realise that pure vulcanised rubber is seldom encountered and that vulcanised products almost invariably contain materials which are put in to give hardness, softness, colour, high strength, resistance to abrasion, low cost, etc., according to the degree in which these qualities are required in the finished product. Common among such ingredients are finely divided carbon (carbon black) for reinforcement and resistance to abrasion, whiting, china clay, wood flour and ground vegetable fibres for hardening and reducing costs; oils and waxes for softening; iron oxide, antimony sulphide and organic dyes for colouring; zinc oxide and certain organic chemicals (accelerators) for assisting the process of vulcanisation. In addition small proportions of preservative substances (antioxidants) are often employed to improve the ageing qualities of the rubber. The importance of adding the most suitable materials in determining the quality of the manufactured goods can hardly be overestimated. It is to the development of this art of compounding rather than to any change in the quality of raw rubber that the enormous improvements of the last twenty years in, for example, the performance of tyres can be traced. It may be of interest to give the constitution of a modern high grade rubber compound and to state the reason for the presence of each ingredient. The example chosen is a tyre tread compound.

Ingredient		Amount	Purpose
Rubber	...	60	
Carbon Black	...	30	for reinforcement
Pine Tar	...	1.4	for softening the rubber and aiding the dispersion of carbon black
Stearic acid	...	2.4	
Antioxidant	...	0.6	for improving ageing
Zinc oxide	...	3	for vulcanisation
Accelerator	...	0.6	
Sulphur	...	2	
		100	

The proportions of rubber in different classes of goods vary between wide limits. Tyre inner tubes may contain 70 per cent by weight of rubber, tyre treads 60 per cent, soles and heels 40 per cent, flooring 20 per cent, erasers 15 per cent. It is therefore quite evident that the rubber content of a compound is no indication of its "quality."

The rubber having been mixed with the necessary compounding ingredients must now be formed into the shape of the finished product. In the majority of cases the rubber is sheeted out by passing it between the steam heated rollers of a calender and from the sheets so formed the articles are built up and vulcanised. Another method of dealing with the compounded rubber is to force it by means of an extruding machine through a die of the required shape. This method is chiefly useful for making long continuous lengths of an uniform small cross section. Rubber tubing is an example of a type of product which is formed by extrusion.

The formed article has finally to be vulcanised or cured. There are several ways of carrying out this operation but they all consist essentially in heating the rubber to a temperature high enough to bring about the reaction between rubber and sulphur within a reasonable time. The most important ways of heating the rubber compound are (1) in a steam heated press (2) in open steam and (3) in hot air. As all these methods are exemplified in the manufactures which have been carried out on a small scale at Dartonfield a short description of a few of these products will now be made.

RUBBER FLOORING (CONTINUOUS SHEET FORM)

One of the essential features of a flooring material is that it should not show a tendency to "creep" under pressure. This property is usually secured by incorporating in the rubber large quantities of mineral or fibrous fillers. For the trials under review the filler chosen was coir fibre waste, a material for which there is no outlet in Ceylon and which is, therefore, available in almost unlimited quantities. It was found that the required mechanical properties could be obtained with a composition made up as follows:—

Rubber	...	2 parts by weight
Coir Waste	...	3 ,, ,, ,,
Mineral ingredients, vulcanising chemicals, etc.		1 part by weight

The method of manufacture was to compound the rubber and then calender into sheets $\frac{1}{8}$ inch thick. In the early trials vulcanisation was effected by heating in hot air but it was later found to be more convenient to select the vulcanising chemicals in such a way that the material was completely cured after about a week's storage in a slightly warmed chamber (35°C.)

It is worth recording that attempts were made to prepare this type of product direct from latex but this method met with little success. No marked advantages attended the use of latex and the products were inferior in appearance to those obtained by the normal method.

RUBBER FLOORING (TILE FORM)

To demonstrate the manufacture of an alternative type of flooring a coir rubber composition was made into the form of tiles. The compounded rubber was here sheeted out to a thickness of $\frac{1}{4}$ inch and then cut into slabs 6 inches square. These slabs were placed in steel moulds of the same size and cured by heating under pressure-in a steam heated press.

The laying of rubber floorings under conditions of high humidity is notoriously difficult and it was found that when coir rubber tilings were laid down on ordinary cement floors moisture was absorbed from the under floor with the result that the tilings worked loose after a comparatively short time. Unfortunately coir fibre is a material which has a marked natural

tendency to absorb water and no completely successful method of combating this tendency has been found. It must, therefore, be concluded that coir fibre is not a specially suitable constituent for flooring materials which are destined to be used under local conditions. The coir rubber materials described above were, therefore, used for making mats and other small domestic articles and attention was given to the manufacture of flooring tiles of an entirely different type.

In view of the extremely severe atmospheric conditions under which flooring must be used locally it was decided to construct a tile in three layers, the bottom layer being as moisture resistant as possible, the middle layer stiff and well loaded to prevent "creep," and the top layer resilient and of the desired colour. The method of manufacture was to mix and sheet out the three compounds separately and then to place them on top of one another so that the total thickness was $\frac{1}{4}$ inch. The composite sheet was then cut into measured slabs and cured in moulds as in the case of the coir rubber tilings.

In connection with the colouring of these tiles it was found that in general organic dyes could not be relied upon to give permanent colours on exposure to tropical light. On the other hand mineral pigments such as iron oxides, chromium oxide and cadmium sulphide gave excellent results.

RUBBER TUBING.

Skill in designing tubing compounds and in operating the extruding machine can only be acquired by experience and the production of extruded goods is less simple than it would appear to be at first sight. The machine itself consists of a horizontal cylindrical chamber which houses a powerful revolving worm. At the forward end of the worm the cylinder is fitted with a die of the required shape. The rubber compound is fed into the chamber where it is caught up by the worm and forced through the die. The tubing so formed is led away from the die to a revolving circular tray on which it is wound up spirally and embedded in talc. The tubing is then placed with the tray in a steam autoclave and cured. Care must be taken that the rubber is so compounded that it does not collapse or lose its shape at the temperature of the cure; on the other hand it must be sufficiently plastic and non-elastic to flow regularly and with a smooth surface from the extruding machine.

BUDGRAFTING STRIP.

Another example of the use of the extruding machine was provided by the manufacture of flat $1\frac{1}{4}$ inch rubber strip for use as a waterproof bandage in the budding of rubber. In this case the material issues from the machine and is conveyed on a cloth band to a bobbin on which it is wound continuously. The cloth conveyor is also wound up and serves to prevent the rubber from sticking to itself. The rubber is then vulcanised by placing the bobbin in the autoclave in open steam.

An alternative method of manufacture which was also employed with success was to run the rubber compound from the calender in thin sheet form and to cure by storage in a warm room for several days. When vulcanised the sheet could then be cut into strips of the required width. The rubber had of course been compounded in such a way that vulcanisation would take place under these conditions.

SQUEEGEE RUBBER AND OTHER MOULDED PRODUCTS.

There is no limit to the variety of small shaped articles which can be made by press moulding provided a mould of the required shape is available or can be constructed. Soles and heels, balls, toys and hot water bottles are examples of this type of product. The articles chosen for demonstration were plain rectangular strips for rubber squeegees. In the manufacture of these the compounded rubber was sheeted on the calender and built up to a thickness of $\frac{5}{8}$ inch. The rubber was then cut into pieces 15 inches $\times$ $2\frac{1}{2}$ inches, pressed into iron moulds of the same size and vulcanised by heating the moulds in a steam heated press.

Although the production of moulded goods is comparatively free from difficulties there are certain properties that it is desirable for a moulding compound to possess. For example, the rubber should not begin to cure in the mould before it has had time to flow completely and it should be easy to remove from the mould when cured; it should also be quite free from trapped air and traces of moisture.

ERASERS

Pencil erasers were made at Dartonfield by moulding the rubber compound in the form of slabs which were subsequently cut into pieces of the required size. The soft, crumbly character

of an eraser is secured by using a small proportion of rubber in conjunction with large amounts of oils and fillers. The filler most generally employed is "factice," a material obtained by the treatment of certain vegetable oils with sulphur or sulphur chloride. Factice possesses slight rubbery characteristics and for this reason is often referred to as rubber substitute.

MISCELLANEOUS PRODUCTS.

In addition to the articles mentioned above a number of other products have been made in response to various requests and enquiries. Rubber cord, tyre repair compounds, heels, door stops, packings, and thin rubber sheet are examples of such products.

The experimental production of vulcanised articles at Dartonfield was undertaken to illustrate the feasibility of manufacturing in Ceylon but it must be admitted that the interest shown by local industrialists has been very disappointing. It is considered, however, that the work has served to demonstrate that a rubber industry in Ceylon would not be attended by any difficulties inherent in the climate or in the capacity of local labour to carry out the essential operations, and that the ultimate success of a local enterprise would depend on economic rather than on technical factors.

THE GIANT SNAIL *ACHATINA FULICA* (Fer)

SUGGESTIONS FOR CONTROL.

[Extracts from a paper by F. Beeley in "The Journal of the Rubber Research Institute of Malaya," 1938, Vol. 8, pp. 130-139. Details of costs have been adapted to meet local conditions.]

THE recent discovery that a certain simple chemical substance when mixed with bran possesses properties both attractant and poisonous to snails has awakened considerable new interest in the subject of control of the local snail pest known as the Giant Snail, *Achatina fulica* (Fer.)

THE NEW "META" BAIT.

The exact origin of the discovery that 'Meta' is attractive and poisonous to slugs appears to be wrapt in mystery, but that it came from South Africa seems certain, which affords some atonement for the fact that Africa seems to have supplied the eastern tropics with Giant Snails in the first place. However, in 1936, according to Gimingham and Newton several letters appeared in British gardening periodicals stating that good results had been obtained by the use of 'Meta'-bran baits for destruction of slugs and snails. These workers, therefore, carried out experiments with the bait, using Paris Green and pure metaldehyde for comparison. They found that the best results were obtained by the use of the 'Meta'-bran baits. This has led to great interest being taken in Malaya regarding the economic possibility of using this chemical for the control of the Giant Snail and slug pests on Rubber estates and in agriculture generally. 'Meta' dry fuel is usually sold in packets of 50 or 100 briquettes each about 2 inches $\times \frac{1}{2}$ inch $\times \frac{1}{4}$ inch, the packets weighing $7\frac{1}{2}$ and 15 oz. respectively. Chemically it consists of commercial metaldehyde which is a polymerised (solid) form of acetaldehyde. It is used essentially for heating small domestic appliances such as kettles, smoothing irons, percolators, curlers, small grills, etc. It is manufactured chiefly in Switzerland and its manufacture and use is covered by patent in United States of America, Great Britain, Canada, India, Japan, China and Australia.

It is not a virulent poison to man, beast or bird, but it should not be placed wantonly in the reach of children or young animals. Dogs, cats and poultry will approach the bait, taste it and then go away. It is unlikely that they would eat sufficient to cause internal poisoning. In comparison with copper and arsenical baits it may be considered as relatively harmless to man, beast and bird; in fact it is our experience that only slugs and snails seem to be affected; only occasionally has the author found a millipede or a beetle among the catch, and it is suspected that being attracted by the smell of the bran they succumbed to the caustic effects of the heavy slimy exudate of the dying snails.

PREPARATION OF THE META-BRAN BAIT.

The apparatus required is very simple and consists of a bucket or glazed earthenware container for mixing the materials, large wood or metal spoon for stirring the mix and a pestle and mortar for breaking down the Meta briquettes to powder form — pressing between folders of strong paper will often suffice.

Supplies of Meta and rice-bran having been obtained the powdered Meta is first mixed with a proportionate amount of rice-bran, and the mixture wetted with water to a consistency of a solid mash easily handled or moulded into balls.

Experiment has shown that useful concentrations of Meta are of the order of $\frac{1}{4}$ oz. or $\frac{1}{2}$ oz. of Meta per one pound of dry rice-bran. There seems little object in increasing the concentration of Meta, and in fact it may be better to put down twice the amount of low concentration bait than to use the stronger bait containing 1 oz. Meta per lb. of bran.

The bait may be distributed broadcast or may be placed in small heaps of one dessert-spoonful at intervals of 10 yards throughout the infested area. The bait is easily washed away by rain and it is recommended that a bamboo shield be placed over the lumps of bait if applied during the wet seasons.

In very heavily infested areas, especially over low lying or swampy land, bait should be placed at more frequent points, say at 5 yards and the dead snails collected and buried each morning, leaving the bait exposed for a further catch.

COST OF META BAIT.

1.	Meta	...	Re. 1.00 per packet ($7\frac{1}{2}$ oz.)
2.	Rice-bran	...	,, 0.03 ,, lb.

Using the concentration of $\frac{1}{2}$ oz. of Meta for 1 lb. of Bran, one packet of Meta requires 15 lbs. of Bran.

Total cost of dry material for 15½ lbs. of dry bait = Re. 1.00 + Rs. 0.45 = Rs. 1-45

It is estimated that one labourer should be able to mix 12 lbs. of bait and place it out at approximately 10 yard points or, better, in alternate intervals between trees in alternate rows. This 12 lbs. bait should be sufficient for an area of about 4 acres. Labour costs will therefore amount to about Rs. 0.11 per acre. Total costs per acre will be as follows:—

3 lbs. of mixed bait	...	Rs. 0.28
Labour ...	...	,, 0.11
Total	...	Rs. 0.39

At 5 yard points the cost will be:—

10 lbs. mixed bait	...	Rs. 0.93
Labour ...	...	,, 0.16½
Total	...	Rs. 1.09½ cents per acre

CALCIUM ARSENATE-BRAN BAIT.

This bait is prepared in a similar way to the Meta-Bran bait except that calcium arsenate is substituted for the Meta powder. This bait is cheaper than Meta but is dangerous to handle in that it is poisonous to other animals; poultry, dogs, etc., which may be tempted to eat it. Though not nearly so spectacular in action as the Meta-bait it has been shown to give fair results and, being more permanent in action, may be relied upon to keep an area free of snails for a considerable period of time. It serves as a useful bait for comparison with the Meta-fuel-bait.

COST OF CALCIUM ARSENATE-BRAN BAIT.

Calcium arsenate costs approximately Rs. 0.33 per lb. Using 1 oz. per lb. of bran:—

1 lb. of calcium arsenate requires 16 lbs. of bran. 17 lbs. of bait cost Rs. 0.33 + Rs. 0.48 = Rs. 0.81 for dry materials.

At 10 yard points total costs per acre will be:—

3 lbs. of mixed bait		= Rs. 0.14½
Labour ...	...	,, 0.11
Total	...	Rs. 0.25½ per acre.

At 5 yard points the cost will be:—

10 lbs. of mixed bait		= Rs. 0.47½
Labour ...	...	,, 0.16½
Total	...	Rs. 0.64 per acre.

CALCIUM ARSENATE-LIME-CEMENT BAIT.

This, even more permanent bait depends for its action upon the fact that snails need an abundant supply of lime for the purpose of making the shell. Limewashed posts and walls, old mortar and similar lime-containing materials are sought after by the snails and may therefore be used as a trap.

Suitable poison-lime bricks are made by mixing 1 part calcium arsenate, 6 parts slaked lime and 2 parts cement, by volume (or 1:4:2 by weight) with sufficient water to form the consistency of an ordinary concrete mix, then allowing to solidify in slab form on a piece of paper. In a few hours the slabs will be hard enough to handle and are ready to be taken out to the field. The poison bricks will remain effective over a period of many months or even two or three years if placed in a reasonably dry situation.

COST OF CALCIUM ARSENATE-LIME-CEMENT BRICKS.

PRICES—LOCAL

Calcium arsenate ...	Rs.	0.33 per lb. (approx.)
Lime	,,	0.01 ,, ,,
Cement	,,	1.60 ,, bag of 94 lbs.

Suitable proportions to give a medium hard brick are:—

1 part calcium arsenate, 6 parts lime, 2 parts cement by volume.

or 1 lb. calcium arsenate, 4 lbs. lime, 2 lbs. cement.

A 7 or 8 oz. briquette is sufficient for one bait.

In bulk:—

28 lbs.	calcium arsenate	Rs.	9.24
112 ,,	lime (slaked) ...	,,	1.12
56 ,,	cement	,,	0.95
196 ,,	material	Rs.	11.31

This is sufficient for 400-450 briquettes or roughly Rs. 0.03 per briquette including labour.

EXPERIMENTS.

[A series of trials is described in the original paper. The following table shows the results of one of the experiments.]

EXPERIMENT No. 1.

Site: Cover Crop Nursery and Garden.

Date: 24.11.37. No. of Dead Snails collected.

Bait: 1 lb. Bran	$\frac{1}{2}$ oz. Meta	1 oz. Meta	2 oz. Meta	2 oz. Calcium arsenate
No. of baits	21 (= 1 lb. mixture)	19 (= 1 lb. mixture)	56 (= 3 lb. mixture)	18 (= 1 lb. mixture)
25-11-37	524	540	767	210
26-11-37	280	366	420	56
27-11-37	196	210	180	14
28-11-37	144	115	110	8
29-11-37	86	86	64	6
30-11-37	31	71	41	0
1-12-37	23	41	28	2
2-12-37	19	22	16	0
3-12-37	14	14	13	0
5-12-37	12	16	12	0
7-12-37	11	14	8	0
Total	1,320	1,495	1,559	296
Catch/1 lb. bait	1,320	1,495	520	296

Some interesting minor experiments have also been carried out in an attempt to determine the cause of the tremendous attractive power of the Meta-bran bait.

Three blocks of Meta were wrapped separately in thin tissue paper and placed in a conspicuous position near a known infested grassy swamp. After three days not a single snail appeared to have been attracted by the Meta, though living snails were observed in the neighbouring grass. On the fourth day one piece of the Meta was taken up, powdered, and while some was made into a rough bran-bait a little of the powder was sprinkled on tissue papers about 6 inches square and placed powder upwards near the original position of the bait. The bran-bait was also placed some 10 yards away along the same grass swamp border. After three more days, whereas the bran-bait had caught many snails, the two original blocks in paper had still no catch and only one of the tissue squares had caught one snail, which had probably wandered blindly on to the paper rather than been attracted.

Bran-mash without the poison is in itself fairly attractive to snails, but apparently not nearly so strongly as the Meta-bran mixture, but the fact is difficult to prove, as snails may eat the unpoisoned bran and wander back to their usual day-time shelter, while in the case of the Meta-bran the snails appear to be rendered incapable of leaving the vicinity of the bait. Thus Meta in its pure state has no attractant power for snails, yet possesses the property of increasing the attractant power of moist bran, and also that of being a violent poison to members of the Mollusca family.

Another interesting observation which has a bearing on the suggestions for field control of this pest was recorded from the writer's garden. This garden had been protected from snails $2\frac{1}{2}$ years ago by placing calcium arsenate-lime-cement bricks at strategic points on the boundaries and at the bases of the larger shrubs within the compound. Though very few of these poison bricks are now recognisable they appear to have been effective, for when recently 2 lb. of Meta-bran bait was laid down only the bait on the boundaries near a rubber field and near the road drain succeeded in killing about 40 snails, while the bait on the other boundaries and within the garden failed to make a catch, yet $2\frac{1}{2}$ years ago this garden was considered very heavily infested.

Thus, while the above experiments demonstrate the phenomenal success in the use of the Meta-bran-bait for snail control they show that it is somewhat fugitive in effect, and for perennial crops such as Rubber one should not lose sight of the

advantages of the more lasting baits which would be more likely to keep an area permanently free of snails.

Hence, in conclusion, it is suggested that for general estate purposes an area should be cleared of snails by the use of the bait of $\frac{1}{2}$ oz. Meta per pound of bran, placed at 15 feet points; then protect the area from further invasion by use of the more permanent and reasonably safe calcium arsenate-lime-cement bricks placed at 15 feet points on the boundaries only.

(*Note.*—Meta is imported to Ceylon by Messrs. A. Baur & Co., Ltd. Calcium arsenate is not obtainable commercially in Ceylon. A small supply has been ordered by the Research Scheme and will be available in small lots for trial.

Costs of materials shown above do not include transport to the estate.

REVIEW.*

Manual of Rubber Planting (Malaya)—Compiled by A. T. Edgar, A.I.S.P. Published by the Incorporated Society of Planters, Kuala Lumpur, F.M.S., 1937, 411 pp. Illustrated. Price $8 (Straits Currency).

THE literature on Rubber planting is extensive and somewhat diffuse; the compilation of a connected account of present day methods, therefore, must have been a task of some magnitude, and planters in Malaya should be grateful to the compiler, Mr. A. T. Edgar, and to the publishers, the Incorporated Society of Planters, for the addition to Rubber planting literature of this Manual of Rubber Planting.

Mr. Edgar is a practical Rubber planter, a fact which is evident from his selection of material and the form of its presentation to the reader. He has drawn freely from the publications of the Rubber Research Institute of Malaya with the result that in Part 1 we are given an authoritative exposition supported by the compiler's personal experience.

In the compass of about 300 pages an account is given of the process of Rubber planting, from selection of the land to preparation of the rubber in the factory. This constitutes Part 1 of this volume, divided into twelve convenient sections. The subjects treated are land tenure, choice of land and opening up, cover crops, planting, budgrafting, seed selection and breeding, maintenance of young clearings and of old rubber, tapping, pests and diseases, manuring old rubber, replanting, collection and preparation, and preservation of latex for export.

Senior planters are probably fully informed on the subjects dealt with in this book; nevertheless, both they and their juniors should find the book useful for reference purposes. Its use in this connexion, however, would have been enhanced by the inclusion of a bibliography of up-to-date literature on rubber

* Reproduced from *The Malayan Agricultural Journal*, 1938, Vol. XXVI, p. 77.

planting. Provision has been made for the issue from time to time of supplements to the volume. Perhaps the compiler will use this means of adding a comprehensive bibliography.

The main purpose of the Manual is to serve as a text book under the Technical Education Scheme of the Incorporated Society of Planters, and for this purpose Part 1 should be admirably suited.

Part II is a collection of articles on a number of subjects connected with the duties of a planter, and therefore lacks the completeness of Part I. Each of the thirteen sections of Part II deals with a particular aspect of planting. Perhaps the most interesting are "Some Notes on Estate Sanitation for Planters," and "Timbers of Malaya," but the other subjects, treating with housing, labour, co-operative societies, estate records, concrete, notes on buildings, surveying instruments and equipment, road making and rainfall are most informative.

The compiler has approached his subject from many angles and the result is an informative volume of value to the reader for whom it was compiled.

[The above publication can be commended to Rubber planters in Ceylon in the absence of an up-to-date text book on Rubber production under local conditions. Allowances should, however, be made for differences in methods and conditions in the two countries.—T. E. H. O'B.]

MEETINGS, ETC.

RUBBER RESEARCH SCHEME (CEYLON)

Minutes of the forty-second meeting of the Rubber Research Board held at Colombo, at 10 a.m. on Thursday, 24th March, 1938.

Present.—Mr. E. Rodrigo, C.C.S. (in the chair), Messrs. Geo. E. de Silva, M.S.C., L. M. M. Dias, F. H. Griffith, M.S.C., R. J. Hartley, Col. T. G. W. Jayewardene, V.D., Messrs. C. E. Jones, C.C.S., (Deputy Financial Secretary), R. C. Kannangara, M.S.C., J. C. Kelly, F. A. Obeyesekere, Col. T. Y. Wright.

Mr. T. E. H. O'Brien, Director, was also present by invitation.

Apologies for absence were received from Messrs. J. L. D. Peiris, C. A. Pereira and B. M. Selwyn.

1. MINUTES.

Minutes of the forty-first meeting which had been circulated to members were confirmed and signed by the Chairman.

2. BOARD.

The Chairman reported that :—

1. Mr. E. C. Villiers had been renominated as a representative of the State Council for a further period of three years from 16th February, 1938.

2. Mr. C. E. Jones, Deputy Financial Secretary, had been nominated to represent the Financial Secretary from 2nd November, 1937.

3. Mr. I. L. Cameron had left the Island on leave and Mr. R. J. Hartley would continue to act for him, as reported at the last meeting.

4. Referring to the impending retirement of Col. T. Y. Wright, the Chairman expressed the Board's gratitude for the valuable services rendered by Col. Wright who had been a member of the Board since its inception and also of the Executive Committee of the old

Rubber Research Scheme since December, 1920. He wished Col. Wright a long and happy life in retirement. A vote of thanks to Col. Wright was adopted with applause.

3. ACCOUNTS

1. *Statement of Receipts and Payments of the Board for the Quarter ended 31st December, 1937*—was adopted.

2. *Statement of Receipts and Payments of the London Advisory Committee for the year ended 31st December, 1937*—was adopted.

3. *Balance Sheet and Auditor General's Report for the year ending 31st December, 1937.*—Supplementary estimates totalling Rs. 9,378 were approved to meet expenditure not previously provided for. It was noted that Rs. 4,000 of the amount represented a book entry to cover the loss on the sale of buildings at Culloden and that there was a saving of Rs. 4,339 on revenue expenditure.

The Chairman pointed out that the Auditor General had included the unappropriated surplus in the capital account. This might give the impression that the Board had decided to reserve the amount to meet capital expenditure, which was not the case. It was decided to record that the surplus funds should be available for any form of expenditure. Subject to this resolution, the accounts and auditor's report were adopted.

The following is a summary of the accounts :—

Income for 1937	...	...	Rs. 230,490
Expenditure for 1937 :—			
Revenue	...	Rs. 140,925	
Capital	...	,, 79,571	Rs. 220,496

4. *Dartonfield and Nivitigalakele Accounts* for December, 1937 — were tabled.

5. *Fixed Deposits.*—The Chairman reported renewal of the following fixed deposits :—

1. Rs. 30,000 at the Chartered Bank of India, Australia and China at $1\frac{3}{4}$ per cent for one year from 5th February, 1938.
2. Rs. 50,000 at the Chartered Bank of India, Australia and China at $1\frac{3}{4}$ per cent for one year from 20th March, 1938.

6. *Revised Estimates for 1938.*—Revised estimates of revenue and expenditure, prepared as requested at the last meeting, were considered

and adopted, in accordance with the following summary :—

		Revised Estimate		Original Estimate
Income for 1938		Rs. 162,978		Rs. 228,000
Expenditure for 1938 :—				
Revenue	Rs. 171,933		Rs. 183,031	
Capital	,, 33,273		,, 54,071	
Revotes	,, 27,733	,, 232,939	,, 27,733	,, 264,835

7. *Investment of Funds.*—Decided that funds available for investment should be placed on fixed deposit for a period of 12 months, after which the question of investment in long term securities should be reconsidered

4. EXPERIMENTAL COMMITTEE.

Minutes of meetings held on 24th February and 14th March were considered.

(a) *Visiting Agent's Report.*—Recommendations arising from the Visiting Agent's inspection of Dartonfield and Nivitigalakele on 10th December, 1937, were adopted.

(b) *Sale of Planting Material.*—Decided that, with effect from 1939, sales of budwood and budded stumps should be restricted to estates which come within the purview of the Smallholdings Department, subject to special arrangements being made for the distribution of material of new clones.

5. STAFF

(a) Reported that Dr. C. E. Ford had accepted appointment as Geneticist and was expected to sail for Ceylon on May 6th.

(b) Agreed that Mr. M. W. Philpott, while on leave in England, should visit certain laboratories and works and that travelling allowances should be paid at the usual rates.

(c) Reported that one probationary rubber instructor had resigned and that his place had been filled.

6. REPORTS.

(a) Technical Officers' Progress Reports for the quarter ended 31st December, 1937, were adopted.

(b) Annual Report for 1937 was considered and adopted, subject to minor amendments in the financial statement.

7. LONDON ADVISORY COMMITTEE FOR RUBBER RESEARCH (CEYLON & MALAYA).

(a) Minutes of meetings of the Committee and Technical Sub-Committee held on 28th January, 1938 were tabled.

(b) A proposal that a member of the Committee's technical staff should visit the East, was considered and it was decided to offer a contribution of Rs. 500 towards the expenses of the visit.

8. VISIT OF SIR FRANK STOCKDALE.

Reported that Sir Frank Stockdale would be visiting the Research Scheme headquarters on 6th April. Agreed that Board members should be notified of the date and time of the visit.

London Advisory Committee for Rubber Research (Ceylon and Malaya).

Member nominated by the Colonial Advisory Council of Agriculture and Animal Health.

Sir Frank Stockdale, K.C.M.G., C.B.E.

Member nominated by the Government of Ceylon.

Dr. W. Youngman, D.Sc., Ph.D.

Member nominated by the Governments in British Malaya.

Mr. J. Lornie, C.M.G.

Members representing Malayan Planting interests — nominated by the Rubber Growers' Association.

Mr. P. J. Burgess (Chairman)
Mr. J. L. Milne.
Mr. Eric Macfadyen.

Members representing Ceylon Planting interests — nominated by the Rubber Growers' Association.

Sir Herbert Wright
Mr. G. H. Masefield
Mr. George Brown.

Member representing Manufacturing interests.

Lieutenant-Colonel J. Sealy Clarke.

Ex-Officio Members.

Sir H. A. F. Lindsay, K.C.I.E., C.B.E., Director of the Imperial Institute.
Professor V. H. Blackman, Director of the Botanical Laboratories, Imperial College of Science and Technology.
Mr. S. F. Ashby, Director of the Imperial Mycological Institute
Sir John Russell, O.B.E., Director of the Rothamsted Experimental Station.

Secretary.

Mr. J. A. Nelson, B.Sc.

The Technical Sub-Committee consists of members of the Advisory Committee with the following co-opted Members.

Mr. G. Martin (Superintendent of Rubber Investigations).
Mr. G. E. Coombs
Mr. Ian. D. Patterson
Mr. B. D. Porritt
Mr. H. N. Ridley
Mr. W. C. Smith
Dr. H. P. Stevens
Dr. D. F. Twiss
Prof. R. G. H. Clements.

STAFF.

Mr. G. Martin, B.Sc., A.I.C., F.I.R.I.
Mr. W. S. Davey, B.Sc., A.I.C., F.I.R.I.
Mr. H. C. Baker, M.Sc., A.I.C., A.I.R.I.

RUBBER RESEARCH SCHEME (CEYLON)

LIST OF PUBLICATIONS FOR SALE.

Bulletins No. 1-20. Bound volume **Rs. 5-00. Later Bulletins Re. 1-00** per copy

No. 1.	The Effect of Tapping on the Movements of Plant-Food in *Hevea Braziliensis.*	
No. 2.	The Effect of Tapping on the Movements of Plant-Food in *Hevea Braziliensis.*	
No. 3.	Seasonal Variations in the Movements of Plant-Food in *Hevea Braziliensis* Part I.	
No. 4.	The Physiological Effects of Various Tapping Systems, Part I.	
No. 5.	Progress Report on Vulcanization Tests.	
No. 6.	The Physiological Effects of Various Tapping Systems, Part II.	
No. 7.	The Physiological Effects of Various Tapping Systems, Part III.	
No. 8.	Seasonal Variations in the Movements of Plant-Food in *Hevea Braziliensis* Part II.	
No. 9.	Vulcanization Tests.	
No. 10.	Vulcanization Tests.	
No. 11.	Variability in Rubber Manufacture.	
No. 12.	Progress Report of the Rubber Research Chemist.	
No. 13.	Vulcanization Tests.	
No. 14.	On the Variation in the Number of Latex Vessels present in *Hevea Braziliensis.*	
No. 15.	Vulcanization Tests.	
No. 16.	On the Natural Clotting of Rubber Latex.	
No. 17.	Vulcanization Tests.	
No. 18.	Measurements of "Bark Renewal."	
No. 19.	Vulcanization Tests.	
No. 20.	Vulcanisation Tests.	
No. 21.	Vulcanisation Tests.	1919
No. 22.	Vulcanisation Tests.	1919
No. 23.	Vulcanisation Tests.	1920
No. 24.	Vulcanisation Tests.	1920
No. 25.	Investigations on Samples of Plantation Para Rubber from Ceylon.	1921
No. 26.	Results of Trials of Ceylon Plantation Rubber for the Manufacture of Ebonite.	1921
No. 27.	Investigations on Samples of Plantation Para Rubber from Ceylon.	1921
No. 28.	Investigations on Samples of Plantation Para Rubber from Ceylon.	1922
No. 29.	Summary of the Principal Results Obtained from Investigations into the Properties of Ceylon Plantation Rubber in Relation to its Method of Preparation.	1922
No. 30.	The Penetration of Disinfectant on the Tapping Cut of *Hevea Braziliensis.*	1922
No. 31.	On the Occurrence of "Rust" on Sheet Rubber.	1923
No. 32.	On the Preservation of Latex.	1924
No. 33.	Investigations on Samples of Plantation Para Rubber from Ceylon.	1924
No. 34.	Investigations on Samples of Plantation Para Rubber from Ceylon.	1924
No. 35.	Investigations on Samples of Plantation Para Rubber from Ceylon.	1924
No. 36.	Investigations on Samples of Plantation Para Rubber from Ceylon.	1924
No. 37.	Investigations on Samples of Plantation Para Rubber from Ceylon.	1924
No. 38.	Investigations on Samples of Plantation Para Rubber from Ceylon.	1925
No. 39.	Do. (Final Report Series I.)	1925
No. 40.	Do. Series II.	1926
No. 41.	Do. First Interim Report on Artificial Ageing Tests.	1926
No. 42.	On the Smoking of Sheet Rubber in Relation to Mould Prevention.	1926
No. 43.	The Inter-Relationship of Yield and the Various Vegetative Characters in *Hevea Brasiliensis* (out of print).	1926
No. 44.	The Construction of Smokehouses for Small Rubber Estates, (out of date).	1926
No. 45.	The Efficiency of Disinfectants and Fungicides.	1927
No. 46.	The Control of Bark Rot by Disinfectants.	1927
No. 47.	Report on Variability of Ceylon Estate Grades.	1927
No. 48.	Brown Bast and its Treatment.	1928
No. 49.	Report on Causes of Variation in Plasticity.	1928
No. 50.	Crepe Rolling.	1929
No. 51.	The Curing of Sheet Rubber.	1930
No. 52.	The Preparation of Uniform Rubber.	1932
No. 53.	Oidium Leaf Disease.	1936
No. 54.	Report on a Visit to Malaya, Java and Sumatra.	1937

Booklets at Rs. 2-50 per copy.

Guide to the Preparation of Plantation Rubber, by T. E. H. O'Brien, M.Sc., A.I.C., Chemist.

The Budding of Rubber, by R. A. Taylor, B.Sc., Physiological Botanist. (out of date).

Diseases of Rubber in Ceylon, by R. K. S. Murray, A.R.C.Sc., Mycologist.

Copies of the following publications of the Rubber Research Institute of Malaya are available at the prices indicated:—

Planting Manual No. 4—Latex Preservation and Shipment **Rs. 3-50.**

Planting Manual No. 5—The History and Description of Clones of *Hevea Braziliensis.* **Rs. 5-00.**